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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/639,625	08/15/2000	Steven Towle	42390P7195	1669

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EXAMINER

OWENS, DOUGLAS W

ART UNIT PAPER NUMBER

2811

DATE MAILED: 11/18/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/639,625

Applicant(s)

TOWLE ET AL.

Examiner

Douglas W Owens

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 August 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-35 is/are pending in the application.
- 4a) Of the above claim(s) 18-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 and 21-35 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-8, 10-12, 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over US patent No. 6,281,584 to Ngo et al.

Regarding claims 1 and 10, Ngo et al. teaches a method of forming a dielectric comprising:

forming a fluorine containing film (64, 106) on a substrate;
forming via openings in the fluorinated material; and
placing the substrate into a reaction chamber and exposing the fluorine containing film to a reducing plasma comprising hydrogen (Col. 4, line 35 - Col. 5, line 4).

Ngo et al. does not teach a method, wherein the reducing plasma is formed in a chamber remote from the reaction chamber. Ngo et al. does not disclose the source of the plasma. Remote plasma is well known in the art and it would have been obvious and necessary for one of ordinary skill to select such a known method. Evidence for the remote plasma being well known is evidenced in Col. 6, lines 1-8 of US patent No. 6,458,645 to DeBoer et al., Col. 7, lines 7-15 of US patent No. 6,472,309 to Li and Col. 4, lines 32-36 of US patent No. 6,475,856 to Yang to name only a few examples.

Regarding claim 2, Ngo et al. teaches a method, wherein the fluorine containing film is a substantially planar layer. Ngo et al. does not explicitly teach a silicon substrate. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a silicon substrate, since it is a known material that is well suited for the intended use.

Regarding claim 3, Ngo et al. teaches a method of forming a dielectric, wherein the fluorine containing film has exposed sidewalls.

Regarding claim 4, Ngo et al. teaches a method, wherein the fluorine film is masked and etched (Col. 7, lines 5-8) to form a pattern (Fig. 10). Ngo et al. does not explicitly teach the fluorine film has a covered top surface. The step of masking the fluorine film before etching it would have required covering the fluorine film. It would have been considered a matter of obvious design choice to not remove the mask layer. Additionally, the completed device shown in Fig. 13 shows that the fluorine film is covered. It would have been a matter of obvious design choice to cover the film before or after depositing the conductive layer.

Regarding claim 5, Ngo et al. teaches a method, wherein the plasma is formed from a hydrogen bearing precursor gas (Col. 2, lines 49-52). Ngo et al. does not explicitly teach using a carrier gas. It would have been obvious to one of ordinary skill in the art to use a carrier gas, since the carrier gas is needed to transport the plasma.

Regarding claim 6, Ngo et al. teaches a method, wherein the hydrogen bearing precursor is NH_3 gas.

Regarding claim 7, Ngo et al. does not teach a method, wherein the carrier gas is N₂, Ar or He. It would have been obvious to one of ordinary skill to select a known gas that is well suited for the intended use.

Regarding claims 8 and 11, Ngo et al. teaches a method, wherein the fluorine containing film is SiOF. Ngo et al. does not teach a method, wherein the fluorine containing film comprises a material selected from the group consisting of a-C:F, parylene AF4, carbon-doped SiOF, fluorinated organic polymers, fluorinated siloxane polymers, and SiOF. It would have been obvious to one of ordinary skill in the art to select from the listed materials since they are known materials that are well suited for the intended use. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding claim 12, Ngo et al. teaches a method of forming a dielectric, further comprising depositing a conductive material (82, 122) in the via openings.

Regarding claim 16, Ngo et al. teaches a method, wherein the plasma is treatment is formed in the milliTorr to Torr range, and the power is in the several hundred Watt range. The ranges disclosed by Ngo et al. overlap those of the claimed invention. Ngo et al. does not teach an argon carrier gas. It would have been obvious to one of ordinary skill in the art to use a carrier gas, since the carrier gas is needed to transport the plasma. It would have been further obvious to select argon since it is a known gas that is well suited for the intended use.

Regarding claim 17, Ngo et al. does not teach a method, wherein the plasma is passed into the reaction chamber at a flow rate in the range of 10 sccm to 3 liters/minute. The flow rate of delivering plasma is a known variable that is subject to optimization. It would have been obvious to one of ordinary skill in the art to find the optimal flow rate through routine experimentation. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

3. Claims 9, 13-15 and 21-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. in view of US patent No. 6,245,662 to Naik et al.

Regarding claims 9, 13, 21, 24 and 31 Ngo et al. teaches a method of forming a dielectric comprising:

- forming a fluorine containing film (64, 106) on a substrate;
- forming via openings in the fluorinated material; and
- exposing the fluorine containing film to a reducing plasma (Col. 4, line 35 - Col. 5, line 4).

Ngo et al. does not teach a method, wherein the fluorinated material consists of a-C:F, parylene-AF4, carbon doped SiOF, fluorinated organic polymers, and fluorinated siloxane polymers. Naik et al. teaches a method wherein the fluorinated low-k material comprises parylene-AF4 (Col. 3, lines 51-61). It would have been obvious to one of ordinary skill in the art to incorporate the material used in the method taught by Naik et al. into the method taught by Ngo et al. since it is a known material that is well suited for

the intended use. It would have been further obvious to one of ordinary skill in the art to select from the listed materials since they are known materials that are well suited for the intended use.

Regarding claim 22, neither Ngo et al. nor Naik et al. teach a method, wherein the reducing plasma is formed in a chamber remote from the reaction chamber. Ngo et al. does not disclose the source of the plasma. Remote plasma is well known in the art and it would have been obvious and necessary for one of ordinary skill to select such a known method as discussed above.

Regarding claims 23 and 32, Ngo et al. teaches a method of forming a dielectric, further comprising depositing a conductive material (82, 122) in the via openings.

Regarding claims 14 and 25, Ngo et al. teaches forming a hardmask layer over the fluorinated material prior to forming the via openings (Col. 7, lines 5-8). Ngo et al. does not teach using parylene-AF4. Naik et al. teaches using parylene-AF4 and forming a hardmask layer (304) prior to forming the via openings. It would have been obvious to one of ordinary skill in the art to incorporate parylene-AF4 for reasons discussed above. It would have been further obvious to employ the hardmask layer since it is desirable to control etching of the fluorinated material.

Regarding claims 15, 26 and 33, Ngo et al. does not teach a hard mask comprising silicon nitride. Naik et al. teaches a method wherein silicon nitride is used for the hardmask layer. It would have been obvious to one of ordinary skill to incorporate the hardmask taught by Naik et al. into the method taught by Ngo et al. for reasons discussed above.

Regarding claims 27 and 34, Ngo et al. teaches a method, wherein the plasma is treatment is formed in the milliTorr to Torr range, and the power is in the several hundred Watt range. The ranges disclosed by Ngo et al. overlap those of the claimed invention. Ngo et al. does not teach an argon carrier gas. It would have been obvious to one of ordinary skill in the art to use a carrier gas, since the carrier gas is needed to transport the plasma. It would have been further obvious to select argon since it is a known gas that is well suited for the intended use.

Regarding claims 28 and 35, Ngo et al. does not teach a method, wherein the plasma is passed into the reaction chamber at a flow rate in the range of 10 sccm to 3 liters/minute. The flow rate of delivering plasma is a known variable that is subject to optimization. It would have been obvious to one of ordinary skill in the art to find the optimal flow rate through routine experimentation. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Regarding claim 29, Ngo et al. teaches a method of forming a dielectric comprising:

- forming a fluorine containing film (64, 106) on a substrate;
- forming via openings in the fluorinated material; and
- exposing the fluorine containing film to a reducing plasma.

Ngo et al. does not teach forming a hardmask on the fluorine containing film. Naik et al. teaches forming a hardmask layer (304) on the fluorine containing film. It

would have been obvious to one of ordinary skill in the art to employ the hardmask layer since it is desirable to control etching of the fluorinated material. There is nothing in the claim to preclude exposing the upper surface of the fluorine containing film to plasma along with the via sidewalls.

Regarding claim 30, Ngo et al. does not teach a method, wherein the reducing plasma is formed in a chamber remote from the reaction chamber. Ngo et al. does not disclose the source of the plasma. Remote plasma is well known in the art and it would have been obvious and necessary for one of ordinary skill to select such a known method.

Response to Arguments

1. Applicant's arguments with respect to claims 1-17 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

2. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

Art Unit: 2811

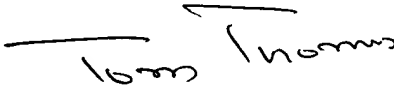
extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas W Owens whose telephone number is 703-308-6167. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

DWO
November 14, 2002


TOM THOMAS
SUPERVISORY PATENT EXAMINER
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